Physical and Chemical Characteristics of Some Sheetings Composed Wholly or in Part of Cotton and Viscose Staple Rayon, before and after Laundering

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PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME SHEETINGS COMPOSED WHOLLY OR IN PART OF COTTON AND VISCOSE STAPLE RAYON BEFORE AND AFTER LAUNDERING 1/

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Summary

The physical and chemical characteristics and the relative performance of fabrics identical in construction but different in fiber content concerns both manufacturer and consumer. Several studies have been reported in which certain physical properties of cotton and rayon fabrics have been compared; however, for these investigations fabrics were, for the most part, selected at random in the retail market. Little is known about the conditions under which they were manufactured, or about the kind of fiber that was used.

In the study reported here, the Bureau of Human Nutrition and Home Economics investigated the physical and chemical properties of utility fabrics (bed sheetings) made from cotton of known genetic origin, and from one type of rayon staple. All fabrics were identical in construction and were manufactured under the same conditions. Thus, the Bureau has begun to accumulate data regarding the effect that replacing various amounts of cotton with rayon has upon the properties of the fabric.

Through the cooperation of the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture, cotton typical of that used in the commercial production of medium weight all-cotton sheetings was procured. The raw cotton of Empire variety of middling grade and 1-1/32 inch staple length was manufactured into an all-cotton bed sheeting in accordance with regular established mill procedures.

Sheetings of the same construction were also made entirely from regular, 1.5 denier, viscose staple rayon, 1-1/4 inches in length, and from blends of the cotton with varying amounts of the viscose staple.

Analysis of the yarns revealed that the breaking strength of the all-cotton yarn was greater than that of yarn spun entirely from rayon staple, and that both the all-cotton and the all-rayon yarns were stronger than those made from blends of the two fibers.

A comparison of the gray and bleached fabrics showed an increase in the count of the all-cotton and the all-rayon sheetings as a result of finishing, but little corresponding change in the blends. The breaking strengths of bleached fabrics (dry) composed of all-cotton and all-rayon were stronger

1/ Report of a study made under the Research and Marketing Act of 1946.

2/ Appreciation is expressed to George S. Wham, Jr., for supervision of fabric manufacture, to Rowena Dowlen for supervision of laboratory analysis, and to the many technicians who assisted with the fabric analyses.

than any of the blends. The breaking strengths of both the gray and bleached mixed fabrics (wet) decreased rapidly as the amount of rayon was increased.

When the seven sheetings composed of varying proportions of cotton and rayon were abraded a total of 3,500 cycles, results showed that both the fabric composition and cycles of abrasion contributed to loss of strength.

Repeated laundering caused an increase in weight per square yard and an increase in count both lengthwise and crosswise. In most instances, the highest count, the greatest shrinkage, and the maximum weight were reached within the first 20 launderings.

The shrinkage brought about by laundering was greater in the filling direction than in the warp. As the amount of cotton increased, the strength index of the laundered sheetings, warpwise and fillingwise, both dry and wet, also increased.

Statistical measures show a positive relationship between the amount of cotton and the breaking strength of the fabric, and also indicate that the proportion of cotton in the fabric has a much greater effect on the breaking strength of these sheetings than does laundering.

The finishing process caused a greater chemical degradation than repeated laundering. In the laundering the chemical degradation during the first five washings was greater than that occurring thereafter through 75 launderings.

Visual examination of the sheetings laundered 75 times revealed that the greatest amount of deterioration occurred in the all-rayon fabric. Of the blended fabrics, those of the higher rayon content showed greater deterioration than those in which cotton predominated.

Judging from the results of this laboratory study, all-cotton sheetings are superior in breaking strength, resistance to abrasion, and dimensional stability to those identical in yarn and fabric construction but composed wholly or in part of viscose rayon staple.

Introduction

In the textile market today are fabrics identical in construction but differing in composition. For example, in various types of fabrics previously made entirely of cotton, there is a growing tendency to replace part of the cotton with rayon, principally because of the price differential. To determine the effect of such replacement upon the properties and ultimate in-service characteristics of a plain weave household utility material (bed sheeting), the Bureau undertook the study reported in this publication.

At the time this research was initiated, sheets containing 50 percent rayon were beginning to appear in retail markets. Substantial displacement in bed sheeting of cotton by rayon would seriously affect the annual consumption of cotton, which is one of the principal agricultural crops in a large section of this country. Furthermore, consumers need factual information to help them evaluate textiles in the retail market and thus enable them to buy the fabrics best suited to specific family requirements.

Manufacture of Yarns and Fabrics

An American Upland cotton typical of that normally selected by mills for the commercial production of sheetings and regular viscose rayon staple of similar length were used to manufacture the fabrics for this study. The fabrics were of medium weight and identical, except for fiber content, in yarn and fabric construction.

The cotton (Empire variety) was of middling grade and 1-1/32 inch staple length. It was grown from pure seed under isolation by the Georgia Agricultural Experiment Station. Care was exercised in its selection to insure as great uniformity as possible in leaf, character, foreign matter, preparation, color, and staple length. The rayon was 1.5 denier, 1-1/4-inch bright staple, regular viscose.

The yarns and fabrics were manufactured by the Textile School of the Clemson Agricultural College in Clemson, South Carolina, under as accurately controlled and comparable conditions as the existing facilities and the nature of the fibers would permit. With only a few minor deviations, the manufacturing processes paralleled those used by commercial plants for the production of sheetings.

Manufacturing Specifications

Seven lots of warp and filling yarns varying in fiber content were spun as follows:

	Yarn Number	Twist Factor	Twist Direction
Warp	22's	4.35	Z
Filling	22's	3.75	Z

The yarns contained the following proportions of the two fibers:

Lot:
1. All-cotton.
2. 5/6 cotton, 1/6 rayon.
3. 4/6 cotton, 2/6 rayon.
4. 3/6 cotton, 3/6 rayon.
5. 2/6 cotton, 4/6 rayon.
6. 1/6 cotton, 5/6 rayon.
7. All-rayon.

The fabric specification was a 64 by 64 count, an average weight of 3.76 yards per pound, and an approximate width of 36 inches from the loom.

Production of Fabrics

The bales of raw fibers were opened, scattered on the picker room floor where they remained for 24 hours for conditioning at room temperatures. Opening was done by passing the rayon two times and the cotton three times through the hopper feeder of the breaker picker with the combing roll set very close. The raw stock was allowed to drop from the hopper feeder to the floor after each successive passage. The fibers for the mixed yarns were blended, sandwich style, on the floor of the picker room.

The organization and speeds of machines for carding, drawing, roving, and spinning were common for all seven fabrics.

In preparation for weaving, the warp bobbins were placed directly in a creel, wound onto four section beams of 584 ends each, and slashed. All the warps were slashed on a Cocker slasher using

the same thin boiling size mixture consisting of water, cornstarch, and plasticizers. The first six drying drums were maintained at a temperature of 180° F. The seventh drum was run cold. The temperature of the size formula, as applied, was 204°. The yarn was stretched approximately 2 percent during slashing.

Weaving was done on automatic looms equipped with reeds having 30 dents per inch and operating at 148 picks per minute. The yarns were drawn-in two ends per dent. A relative humidity of approximately 70 percent was maintained during weaving. The filling yarns were rewound from the spinning bobbins to filling bobbins on a Universal winder.

All fabrics were desized, scoured, and bleached in a laboratory dye tub, following a modified commercial procedure with hydrogen peroxide as the bleaching agent.

Analytical Procedures

To check compliance with manufacturing specifications, samples were withdrawn at each successive stage of manufacturing from the opening of the raw fiber to the finishing of the woven fabric. These samples were conditioned in a room maintained at 65 percent relative humidity and 70° F. After they had reached moisture equilibrium, certain physical properties of the yarn and fabrics were analyzed.

Yarns.--The yarn number was determined on a direct reading yarn-numbering balance. Ten readings were taken for each set of warp and filling yarns from each of five bobbins. The average of the 50 determinations was reported.

The amount of twist in the yarns was determined on a twist-tester machine of the type described in ASTM D76-42 (1) 3/. The average of the readings on fifty specimens taken from five bobbins of yarn was regarded as the number of turns per inch.

The breaking strength and elongation of the yarns were determined on a single-end incline-plane serigraph-type machine having a capacity of 500 grams. The jaws were set 10 inches apart at the beginning of each test. The average of fifty determinations was taken as the strength of the yarn. The elongation of the yarns, automatically recorded at the instant of yarn break, was reported in percent.

Fabrics.--Laboratory analyses of count, weight, and breaking strength (raveled strip) were made on the gray goods, the finished fabrics, and the laundered fabrics. Shrinkage was measured on both the finished and laundered cloth, whereas resistance to abrasion was determined only on the new sheetings.

The number of yarns in one inch of fabric was counted with a micrometer counter on alternate warp and filling breaking strength strips after they were prepared for testing. The average of five readings was reported as the count.

To determine the weight of the sheetings, five 2-inch square specimens were cut with a die diagonally across the sampling area. The samples were then weighed on a torsion balance calibrated to read in ounces per square yard.

3/ Numbers in parenthesis refer to Literature Cited, p. 9.

Shrinkage of the finished fabrics was determined in accordance with the standard method, ASTM D437-36 (1). In order to ascertain the dimensional change that occurred during successive laundering, three 18-inch distances were marked in the warp and filling directions, and measured after 10, 20, 30, 40, 50, and 60 washings. Shrinkage was reported as the percentage of the dimensions of the unlaundered material. The sheetings were laundered commercially, using a modification of the method ordinarily employed for lightly soiled white goods. The procedure consisted of one suds 12-15 minutes at 150° F., using sufficient neutral soap conforming to Federal Specification PS 566a to produce a good running suds, two rinses at 140° F., and two at 120°. No bleach or sour was used.

Raveled strip breaking strengths, both wet and dry, were measured in accordance with procedures outlined in ASTM D 39-39 (1). The mean of 10 values was regarded as the breaking strength of the fabric. The elongations of the 10 strips, automatically recorded at the instant of fabric break, were averaged, the percent calculated and reported.

Resistance to abrasion was determined on the Taber Abraser using CS-8 Calibrase wheels with a 250-gram counterweight as the abradant. Sufficient 6-inch squares for each testing interval were cut from each fabric and then randomized. Conditioned samples were abraded a predetermined number of cycles from 500 to 3,500 in steps of 500. The lint formed during abrasion was removed with a soft brush. At the end of 1,000 cycles the wheels were refaced by running them 25 cycles on carborundum paper.

From each abraded specimen two warpwise and two fillingwise strips were cut 1-1/4 inches wide, raveled to 1 inch in width, and broken on a Suter pendulum-type breaking strength machine having a 1-inch gauge length and a capacity of 0 to 100 pounds. The average of ten readings (warpwise or fillingwise) was regarded as the breaking strength of the fabric. The reduction in strength expressed as percent loss versus cycles of abrasion was taken as the measure of the extent of damage.

Chemical determinations of fiber content, amount of sizing, and the degradation, as measured by the fluidity in cuprammonium solution and the viscosity of cellulose nitrate in butyl acetate, were made on the gray and finished fabrics. Oven dry weights were used in calculating the results of all chemical analyses.

The fiber content of the blends was determined by dissolving out the rayon in 60 percent sulfuric acid according to the method of Howlett, Morley, and Urquhart (4). Since it was found that an appreciable amount of cotton also dissolved, blanks were run on the cotton and the final results corrected for the solubility of the cotton. Total sizing on the fabrics was found by immersing samples in gently boiling 0.1 N nitric acid for 10 minutes according to ASTM method 628-42T (1).

Fluidity (reciprocal viscosity) measurements in cuprammonium solution were made according to the standard ASTM method D539-40T (1), with the following changes: 80 mesh copper gauze was used instead of powdered copper in making up the solution and the samples were dissolved in mixing vials similar to those used by Mease (5), then transferred to the viscometers for measurement. The weight of samples used for the viscosity determinations was calculated to give the following solutions for the various sheetings: All-cotton, 0.50 percent; 5/6 cotton, 0.75 percent; 4/6 cotton, 1.00 percent; 3/6 cotton, 1.25 percent; 2/6 cotton, 1.50 percent; 1/6 cotton, 1.75 percent; and all-rayon, 2.00 percent.

Viscosity measurements of cellulose nitrate in butyl acetate were made according to the method of Hessler, Merola, and Berkley (3). The cellulose samples were nitrated for one-half hour at room temperature with a mixture of 56 percent HNO_3, 39 percent H_3PO_4, and 5 percent P_2O_5 using a 1:100 ratio of fiber to nitrating mixture. The viscosities were determined at 25° C. in Cannon-Fenske pipettes which had been previously calibrated with standard viscosity oils supplied by the National Bureau of Standards. Different size pipettes were used, ranging from a No. 200 for all cotton to No. 50 for all rayon. A 0.1-percent concentration of cellulose nitrate was used in all cases. The degree of polymerization (D.P.) of each sample was calculated from the viscosity of the corresponding cellulose nitrate using the formulas $[\eta] = 2.3 \log \eta_r (1 + 0.5\ c)$ and D.P. = 270 $[\eta]$ as reported by Hessler et al.

Discussion of Results

The data revealed that greater changes in strength resulted from varying the proportions of cotton and rayon in the sheetings than from laundering (tables 1 to 4). Results of the laboratory analysis of yarns and sheetings composed entirely of cotton, entirely of rayon, and of blends of cotton and rayon are given in tables 5 to 7, and in figures 1 and 2.

Yarn properties.—Laboratory analysis of the chemical and physical properties of the yarns are reported in table 5. Results show that the turns per inch and yarn number were within the normal manufacturing tolerances of the specifications.

Breaking strength determinations revealed that the all-cotton and all-rayon yarns were stronger than any of the blends, and that the all-cotton yarns were stronger than the all-rayon. These findings are in accord with a report on a study of staple length and blend of yarns in which Ashton (2) stated that "several blended yarns have lower strengths than either the pure-cotton or pure rayon yarns."

No definite trend was apparent between breaking strength and fiber content of the blended yarns. The total variability in the breaking strength among yarns differing in fiber composition ranged from 9.7 to 16.6 percent warpwise and from 10.7 to 13.1 percent fillingwise.

The all-rayon yarns elongated the most and the all-cotton the least. The elongation increased as the rayon content of the yarns was raised. The most rapid increase occurred in the yarns containing more than 50 percent rayon.

Fabric properties.—Analysis of the gray cloth showed that all fabrics conformed to the manufacturing specifications with respect to fiber content, number of yarns per inch, and weight per square yard. The amount of sizing varied from 6.0 to 8.7 percent on the gray and from 0.8 to 1.7 percent on the finished fabrics.

Finishing apparently affected the count of the all-cotton and the all-rayon sheetings more than that of any of the blends. With finishing, the number of warp yarns per inch in the all-cotton and all-rayon fabrics was increased from 64 and 65 to 74 and 73, respectively. In the blended sheetings, whether finished or unfinished, the number of warp yarns per inch varied little. The filling count was about the same for all fabrics, both gray and bleached.

When laundered once by the standard laboratory procedure (ASTM D4 37-36), the all-cotton bleached sheeting shrank the least (7.6 percent in the warp and 2.6 percent in the filling), and the all-rayon the most (15.9 and 10.9 percent in warp and filling, respectively). The percent shrinkage of the five mixed sheetings ranged from 7.6 to 11.1 percent warpwise and from 7.0 to 9.3 percent fillingwise.

There was no definite trend in the difference in strength of the gray goods (dry) as the rayon content increased (fig. 1). Upon finishing, the changes in strength varied more fillingwise than warpwise. The breaking strengths of both the gray and bleached mixed fabrics (wet) decreased rapidly with an increase in rayon content. As in the yarns, the warp breaking strengths of the all-cotton and all-rayon bleached sheetings (dry) were higher than any of the blends (table 6).

The percent elongation of the gray cotton sheeting (dry) was slightly higher than that of several of the blends. As the amount of rayon increased, the elongation gradually increased until the fabric made entirely of rayon staple ranked above the other sheetings in this respect. After finishing, the warpwise elongations of the all-cotton and the five blended sheetings (dry) were in close agreement (table 6). In the bleached fabrics, the fillingwise elongation (both dry and wet) of the all-rayon and all-cotton was greater than that of the mixed sheetings. A similar relationship was shown in the elongation of the gray sheeting (wet) in warp and filling directions.

That chemical degradation occurred during the finishing process was indicated both by the fluidities in cuprammonium solution and by the degrees of polymerization calculated from cellulose nitrate viscosity measurements. The bleached all-cotton and blended sheetings containing 2/6 or more cotton showed an increase in fluidity of about 2 rhes, the 1/6 cotton- of 5 rhes, and the all-rayon of 0.3 rhes. A decrease of approximately 30 percent in the degrees of polymerization was found for all fabrics except the 1/6 cotton and the all-rayon, which decreased 40 percent and 1 percent, respectively. Thus with both methods the materials containing 1/6 cotton showed the greatest chemical degradation; the all-rayon the least. The small amount of chemical degradation found in the all-rayon fabric may be due to the milder finishing treatments used for this fabric than for sheetings containing cotton.

Effect of Laundering

Visual examination of the sheetings laundered 75 times revealed that the greatest amount of deterioration occurred in those of higher rayon content. The most typical failures were caused by broken filling yarns. The size of the holes and thin places was in direct relationship to the amount of rayon in the sheetings.

Repeated laundering caused an increase in the weight and in the number of yarns per inch in all fabrics. In most instances, the highest count, the greatest shrinkage, and the maximum weight were reached between 10 and 20 launderings (table 7). With one exception the shrinkage of all the sheetings was greater in the filling than in the warp direction. The all-rayon material showed the greatest shrinkage and was the only fabric to show a trend toward an increase in this property with an increase in the number of launderings.

The greatest increase in weight due to shrinkage occurred within the first five launderings. During this period, the all-cotton fabric gained

10.9 percent whereas the sheetings composed entirely of rayon and of blends of cotton and rayon increased from 16.7 percent to 25.6 percent.

Within the first five launderings the breaking strength of all the fabrics, both dry and wet, increased. The all-cotton sheeting, which had the highest initial strength, gained 2.8 percent in dry warp strength and 16.6 percent in dry filling strength. The remaining sheetings composed entirely or in part of rayon increased more in dry breaking strength warpwise than fillingwise. This latter relationship is in accord with the greater warp count and the higher fillingwise shrinkage which occurred within the first testing interval.

The strength index 4/, another measure for evaluating breaking strength, takes into account the change in count caused by shrinkage. After 75 launderings, the strength index of the all-cotton sheeting remained the highest (table 7). As the percentage of cotton was decreased and the percentage of rayon increased, the strength index in warp and filling directions, both dry and wet, became lower.

The analysis of variance of the breaking strength data for the seven types of sheetings shows that fabric content is a highly significant factor (table 1). Number of launderings, the second source of variation, is significant in the breaking strength of the dry fabric but not in the wet.

Analysis of covariance (table 2) indicates that the correlation coefficients for the breaking strengths (dry) in both the warp and filling directions of the three sheetings composed of 4/6 rayon, 5/6 rayon, and all-rayon were significant at the 1 percent level. Those for the 5/6 cotton fabric in the warp and the all-cotton in the filling were significant at the 5 percent level. Figure 2 shows a negative relationship between number of launderings and breaking strength. The intercepts indicate a tendency for the regression of breaking strength on the number of launderings to increase with the increase in cotton content. Since no definite significance is indicated until as much as 4/6 rayon content is reached, the apparent relationship of the dry breaking strengths of two fabrics of higher cotton content is probably due to chance. A larger sampling, a longer period between testing intervals, and a greater number of launderings might have given different results.

An analysis of multiple correlation using breaking strength as the dependent variable and amount of cotton and number of launderings as the independent variables shows that with 980 observations, 67 percent of the variation in warpwise breaking strength (dry) and 58 percent in the fillingwise strength are associated with the factors of fabric content and number of launderings. Similarly, 92 percent of the variation in warpwise breaking strength (wet) and 86 percent in the fillingwise strength are associated with these two variables.

The standard regression coefficients of breaking strength on percent of cotton, independent of launderings, were 0.80 and 0.96 warpwise, and 0.73 and 0.91 fillingwise. For dry and wet breaking strength on number of launderings, independent of percent cotton, these coefficients were -0.18 and -0.05 warpwise, and -0.21 and -0.16 fillingwise for dry and wet breaking strength, respectively. The beta coefficients show that changes in breaking strength due to varying the fabric composition were greater than those due to laundering.

4/ Strength index = $\frac{\text{breaking strength}}{\text{yarns per inch}}$

In general there was a larger increase in chemical degradation from 0 to 5 washings than from 5 to 75. This relatively large change during the first five launderings may be due to the fact that some of the cellulose bonds weakened by the oxidizing bleach were not broken until the fabric was washed in the alkaline soap solution. After these easily ruptured bonds were broken, additional laundering by the method used in this study caused only a very slight chemical deterioration in any of the fabrics.

Effect of Abrasion

Resistance to abrasion was measured by the degree of reduction in breaking strength. Analysis of variance (table 3) shows that the seven sheetings differed significantly in breaking strength when abrasion was applied; likewise, the cycles of abrasion affected the breaking strength of the fabrics to a high degree. The interaction term (number of fabrics times cycles of abrasion) was not significant warpwise; however, it was highly significant fillingwise.

Analysis of covariance (table 4) shows a strong negative correlation between cycles of abrasion and breaking strength. The intercepts for the five blended fabrics indicate a tendency for the regression of breaking strength on the cycles of abrasion to increase as the amount of cotton in the sheetings increases.

An analysis of multiple correlation, using breaking strength as the dependent variable and amount of cotton and cycles of abrasion as the independent variables, shows that with 490 observations, 80 percent of the variation in breaking strength warpwise and 74 percent fillingwise are associated with the factors, fabric content, and cycles of abrasion. The standard regression coefficients of breaking strength on cycles of abrasion independent of percent cotton are -0.77 warpwise and -0.82 fillingwise. The standard regression coefficients of breaking strength on percent of cotton independent of cycles of abrasion are 0.46 warpwise and 0.25 fillingwise. These beta coefficients indicate that the amount of cotton used in the sheetings had more effect on the breaking strength warpwise than fillingwise and that cycles of abrasion had a highly significant effect.

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Table 1. - Analysis of variance of the breaking strength of the laundered sheetings

Source of variation	D/F 1/	Mean square variance among the breaking strength of the fabrics 2/			
		Dry		Wet	
		Warp	Filling	Warp	Filling
Fabrics................	6	7,121.08**	7,084.72**	34,901.30**	25,762.04**
Launderings............	13	315.40*	493.92**	99.96	218.48
Interaction 3/.........	78	99.59**	44.63**	68.41**	114.39**
Sampling error.........	882	11.65	12.52	9.43	13.40

*Significant variance.

**Highly significant variance.

1/ D/F indicates degrees of freedom.

2/ Determinations of breaking strength were made at intervals of 5 launderings.

3/ Interaction consists of fabrics times launderings.

Table 2. - Analysis of covariance in breaking strength of the laundered sheetings

Fabric	D/F 1/	Regression and correlation coefficients for the breaking strength of fabrics 2/							
		Dry				Wet			
		Warp		Filling		Warp		Filling	
		Correlation	Regression	Correlation	Regression	Correlation	Regression	Correlation	Regression
All-cotton......	139	-0.091	-0.016	-0.180*	-0.048	-0.088	-0.029	-0.462**	-0.187
5/6 cotton...... 1/6 rayon	139	-.165*	-.033	-.016	-.003	-.201*	-.034	-.262**	-.066
4/6 cotton...... 2/6 rayon	139	-.119	-.027	-.148	-.038	-.189*	-.037	-.580**	-.160
3/6 cotton...... 3/6 rayon	139	-.014	-.003	-.253**	-.052	-.041	-.006	-.148	-.030
2/6 cotton...... 4/6 rayon	139	-.421**	-.091	-.631**	-.141	-.350**	-.043	-.583**	-.105
1/6 cotton...... 5/6 rayon	139	-.649**	-.126	-.795**	-.150	-.413**	-.031	-.615**	-.052
All-rayon.......	139	-.767**	-.206	-.622**	-.128	-.740**	-.092	-.581**	-.057

*Significant variance.

**Highly significant variance.

1/ D/F indicates degrees of freedom.

2/ Determinations of breaking strength were made at intervals of 5 launderings.

Table 3. - Analysis of variance of the breaking strength of the abraded sheetings

Source of variation	D/F 1/	Mean square variance among breaking strength for fabrics abraded 3,500 cycles	
		Warp	Filling
Fabrics.............	6	1,955.16**	1,104.68**
Cycles of abrasion...	6	5,210.74**	6,105.19**
Interaction 2/.......	36	20.04	54.98**
Sampling error.......	441	21.37	18.31

**Highly significant variance.

1/ D/F indicates degrees of freedom.

2/ Interaction consists of fabrics times cycles of abrasion.

Table 4. - Analysis of covariance in breaking strength of the abraded sheetings

Fabric	D/F [1]	Regression and correlation coefficients for breaking strength of fabrics abraded 3,500 cycles			
		Warp		Filling	
		Correlation	Regression	Correlation	Regression
All-cotton..........	69	-0.878**	-0.00872	-0.910**	-0.01166
5/6 cotton-1/6 rayon	69	-.871**	-.00850	-.804**	-.00667
4/6 cotton-2/6 rayon	69	-.847**	-.00723	-.874**	-.00774
3/6 cotton-3/6 rayon	69	-.819**	-.00716	-.935**	-.00909
2/6 cotton-4/6 rayon	69	-.843**	-.00736	-.889**	-.00879
1/6 cotton-5/6 rayon	69	-.901**	-.00758	-.924**	-.00797
All-rayon...........	69	-.854**	-.00861	-.845**	-.00789

**Highly significant variance.

1/ D/F indicates degrees of freedom.

Table 5. - Physical properties of the all-cotton, all-rayon, and blended yarns used in the manufacture of sheetings

Yarn	Yarn number 1/		Turns per inch 1/		Sizing on warp	Breaking strength 1/ (single strand)				Elongation 1/	
						Warp		Filling			
	Warp	Filling	Warp	Filling		Mean	C 2/	Mean	C 2/	Warp	Filling
			Number	Number	Percent	Grams	Percent	Grams	Percent	Percent	Percent
All-cotton.......	21.5	21.5	22.4	19.1	11.9	364.4	10.2	353.0	10.9	5.0	4.7
5/6 cotton....... 1/6 rayon	21.9	22.5	21.6	18.2	12.6	317.8	12.3	283.0	12.1	6.0	5.5
4/6 cotton....... 2/6 rayon	21.2	22.6	20.8	18.6	13.6	325.9	16.6	289.1	11.7	6.6	5.2
3/6 cotton....... 3/6 rayon	23.3	23.0	20.4	18.1	13.7	258.9	9.7	295.9	10.7	6.3	6.2
2/6 cotton....... 4/6 rayon	22.4	22.6	21.6	18.2	13.4	271.4	14.6	271.3	12.2	8.0	8.2
1/6 cotton....... 5/6 rayon	22.4	24.1	20.7	17.4	13.1	302.5	14.6	290.3	13.1	11.0	11.3
All-rayon........	22.9	23.6	19.8	16.8	12.6	327.3	14.0	346.5	11.7	13.6	14.2

1/ Average of 50 determinations in each direction.

2/ C = coefficient of variation.

Table 6 - Breaking strength and elongation of the sheetings before and after laundering

Times laundered	Breaking strength 1/								Elongation 1/			
	Dry				Wet				Dry		Wet	
	Warp		Filling		Warp		Filling		Warp	Filling	Warp	Filling
	Mean	C 2/	Mean	C	Mean	C	Mean	C				
No.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.
					All-cotton fabric							
0	50.5	6.3	37.9	7.2	63.5	7.0	53.4	5.7	6.4	9.0	10.2	11.6
5	51.9	13.7	44.2	21.4	54.1	15.0	60.7	5.9	11.5	14.7	13.3	17.7
10	44.3	10.0	47.8	12.8	53.6	15.6	48.1	16.4	12.3	17.2	14.6	15.4
15	48.3	10.6	37.8	8.2	52.8	14.3	41.8	25.2	19.2	19.3	16.9	12.7
20	50.5	7.3	42.6	12.1	51.6	10.1	51.9	14.8	11.9	17.9	16.6	17.8
25	52.8	5.7	49.9	4.0	60.8	3.7	59.2	9.4	10.6	15.6	15.8	18.7
30	47.4	12.1	43.0	14.6	62.2	6.0	51.4	1.5	10.7	18.2	15.4	16.8
35	45.3	4.5	44.3	9.8	51.3	14.7	51.0	12.9	12.5	16.9	14.8	18.3
40	51.3	5.8	42.2	10.6	57.9	6.4	47.7	8.8	8.5	14.8	11.4	13.0
45	50.6	8.2	45.9	9.3	59.4	7.1	49.6	5.8	10.2	13.8	13.3	14.2
50	51.1	7.0	45.4	9.4	51.0	7.9	45.2	11.5	9.8	16.4	15.9	17.4
55	51.2	7.4	46.0	6.1	51.2	6.0	43.8	11.1	10.1	16.5	15.8	19.5
60	42.0	5.8	42.8	8.1	44.6	17.5	40.1	14.8	11.6	18.0	17.3	18.8
65	47.2	8.1	38.2	7.9	55.0	8.1	42.4	6.0	11.0	16.9	14.0	15.7
75	49.8	6.1	40.0	5.3	57.0	2.2	43.2	14.0	10.1	16.6	16.1	17.4
					5/6 cotton-1/6 rayon fabric							
0	34.3	5.3	31.4	8.1	40.6	4.6	38.4	6.9	5.0	5.8	8.2	9.6
5	45.0	11.5	35.0	11.9	45.6	10.3	42.0	10.6	8.6	14.6	14.6	16.8
10	41.4	8.0	39.4	9.3	44.4	8.6	37.8	17.5	11.1	13.6	13.2	14.5
15	38.4	22.5	32.7	18.8	42.6	13.2	35.2	15.6	11.0	16.2	14.1	14.7
20	46.2	3.5	41.0	8.4	50.0	6.3	44.4	6.9	11.0	17.0	14.0	16.9
25	43.8	4.2	37.4	5.7	47.9	6.3	38.4	12.8	9.3	15.2	13.8	15.4
30	43.9	10.8	34.8	13.1	46.4	9.7	38.6	17.5	9.6	15.2	13.8	16.7
35	44.9	4.4	36.8	7.9	46.4	7.8	40.0	6.0	12.3	17.1	13.5	15.6
40	43.8	6.2	32.9	9.5	47.8	7.7	40.0	13.9	8.7	13.1	9.4	12.9
45	45.0	4.9	37.3	13.8	47.1	6.1	39.9	5.6	9.2	14.8	10.8	13.3
50	42.1	6.2	38.4	7.8	41.8	7.2	38.5	9.8	8.4	12.2	13.1	14.8
55	41.7	6.3	39.7	5.5	45.8	6.0	42.6	9.2	11.5	17.7	12.6	16.1
60	39.6	5.7	36.4	5.3	44.7	4.5	36.4	13.3	10.2	19.4	12.7	15.0
65	42.6	6.7	35.6	9.9	44.2	4.1	35.6	8.3	11.9	16.7	12.7	15.8
75	40.4	3.2	35.4	5.6	41.9	7.8	34.0	10.7	14.9	17.0	13.5	15.7

1/ Average of 10 observations.
2/ C = coefficient of variation.

Table 6. - Breaking strength and elongation of the sheetings before and after laundering - Continued

Times laundered	Breaking strength 1/ Dry Warp Mean	Dry Warp C 2/	Dry Filling Mean	Dry Filling C	Wet Warp Mean	Wet Warp C	Wet Filling Mean	Wet Filling C	Elongation 1/ Dry Warp	Dry Filling	Wet Warp	Wet Filling
No.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.
					4/6 cotton-2/6 rayon fabric							
0	33.6	5.8	30.4	11.3	38.0	5.8	29.9	13.3	5.1	6.3	8.4	9.3
5	43.1	8.0	33.8	19.3	42.7	7.8	37.1	10.2	10.4	14.4	14.6	16.5
10	45.0	7.7	38.0	9.6	42.0	8.7	37.8	12.6	10.3	14.7	14.6	15.3
15	46.0	3.8	37.4	10.0	45.8	4.9	39.9	10.7	13.4	18.6	14.6	17.5
20	31.9	17.7	32.2	10.5	32.2	18.3	35.2	12.8	13.2	18.6	16.6	18.0
25	43.2	7.6	41.4	9.7	43.0	5.0	40.6	11.9	12.3	16.4	13.5	14.3
30	37.3	19.0	31.6	25.4	44.0	6.2	35.8	12.7	14.8	18.5	14.1	16.3
35	41.4	8.6	34.8	5.1	39.8	5.9	30.7	12.0	10.0	18.7	16.3	17.6
40	41.4	5.4	32.2	10.9	38.1	6.2	30.8	13.0	10.1	13.3	13.1	13.8
45	43.0	6.5	26.8	18.2	39.9	4.6	27.4	16.1	9.5	13.1	10.1	12.6
50	44.0	4.6	35.0	6.0	41.7	4.2	34.3	7.1	10.4	16.9	13.8	15.9
55	38.3	6.8	33.9	11.1	41.2	5.0	33.0	8.4	10.8	18.6	14.2	15.2
60	40.0	5.2	35.0	10.1	40.8	2.8	25.8	9.4	9.4	18.2	11.7	14.1
65	40.4	5.9	34.7	8.4	39.0	10.0	31.3	4.6	11.7	17.8	15.4	12.6
75	41.2	1.7	34.2	16.1	38.8	6.6	29.0	11.2	10.8	16.5	14.5	15.5
					3/6 cotton-3/6 rayon fabric							
0	33.7	3.7	22.2	13.4	26.3	9.1	21.2	14.6	6.3	6.4	8.0	8.0
5	39.2	13.8	31.4	14.4	34.1	12.6	29.6	11.8	9.8	14.5	14.2	14.4
10	41.9	8.3	33.3	10.2	34.6	6.3	28.5	15.1	11.3	14.3	13.4	15.2
15	36.0	17.2	32.8	8.2	33.8	11.8	28.7	9.6	11.6	18.4	15.0	15.9
20	34.0	9.3	28.4	16.4	32.6	11.5	27.7	10.2	13.0	17.7	15.7	15.9
25	42.6	6.8	36.8	9.6	33.4	6.2	30.8	9.6	12.2	16.4	14.6	15.6
30	40.7	6.3	33.8	9.5	34.2	8.7	29.8	7.6	12.2	17.0	14.0	15.9
35	39.6	5.9	30.0	6.6	31.7	3.0	24.5	11.0	10.3	17.7	11.2	14.6
40	42.1	3.8	32.0	5.7	32.1	5.8	25.2	11.2	8.9	13.6	10.2	13.0
45	39.6	6.2	25.9	8.7	33.2	7.2	24.8	9.2	10.3	12.7	11.5	12.9
50	38.4	4.4	30.7	9.8	30.0	5.0	26.9	5.1	11.2	16.9	15.1	15.2
55	36.8	7.4	27.6	23.4	32.4	4.1	21.6	18.9	13.9	16.1	13.2	14.5
60	37.2	7.2	33.0	9.9	31.8	8.0	22.0	20.1	11.9	18.0	12.0	14.3
65	36.6	5.0	30.9	2.4	33.0	5.8	23.9	8.6	12.4	18.0	15.4	14.8
75	39.3	13.0	28.5	8.5	38.6	3.8	22.2	3.0	12.1	16.6	14.3	14.1

1/ Average of 10 observations.
2/ C = coefficient of variation.

Table 6 - Breaking strength and elongation of the sheetings before and after laundering - Continued

Times laundered	Breaking strength 1/ Dry Warp Mean	Dry Warp C 2/	Dry Filling Mean	Dry Filling C	Wet Warp Mean	Wet Warp C	Wet Filling Mean	Wet Filling C	Elongation 1/ Dry Warp	Dry Filling	Wet Warp	Wet Filling
No.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.
2/6 cotton-4/6 rayon fabric												
0	30.7	13.3	27.6	9.0	19.8	9.5	15.8	8.5	6.0	8.3	7.3	7.8
5	38.1	8.8	34.4	11.6	25.7	8.1	23.8	19.6	13.3	18.2	14.4	17.4
10	40.1	5.6	34.2	10.6	28.3	9.8	25.0	6.8	11.4	18.9	14.8	15.9
15	33.2	23.0	28.3	16.1	24.8	17.8	19.8	8.2	12.9	18.2	14.3	15.9
20	38.1	9.8	31.4	12.5	27.8	4.8	24.0	8.8	15.0	19.4	15.1	16.9
25	37.0	3.3	34.2	4.6	23.6	7.5	24.8	8.3	15.8	18.3	13.2	15.8
30	37.4	5.5	29.0	8.2	27.5	6.6	20.4	10.4	12.5	18.1	14.2	14.9
35	33.4	5.2	30.7	15.9	25.0	7.6	21.9	10.1	16.2	16.4	13.7	14.6
40	36.4	3.5	28.1	8.5	26.5	4.4	23.4	8.0	11.1	14.5	12.5	14.0
45	37.8	4.4	28.6	8.8	24.8	6.7	20.0	6.4	9.8	16.2	12.5	13.8
50	36.5	5.8	26.8	10.2	26.0	8.0	19.6	16.8	9.3	13.2	12.5	11.5
55	32.8	7.6	25.6	4.7	25.0	3.8	20.9	7.0	12.0	18.8	14.2	14.9
60	26.4	11.2	21.4	6.8	23.2	10.7	18.6	7.9	13.1	18.7	12.5	14.2
65	34.8	3.7	25.2	5.5	25.0	4.6	16.8	20.8	12.7	18.1	14.3	14.0
75	33.8	11.4	27.1	9.5	23.2	8.0	16.4	8.3	10.9	18.6	13.0	12.7
1/6 cotton-5/6 rayon fabric												
0	27.0	5.4	19.1	12.1	8.2	11.5	6.0	16.2	6.6	8.2	5.1	4.8
5	35.9	6.3	25.0	9.2	15.6	9.6	11.8	17.9	10.3	16.2	10.8	11.6
10	33.9	4.9	26.4	10.8	15.2	6.6	13.0	8.3	12.5	17.3	10.1	12.6
15	32.4	13.0	27.1	11.8	15.2	9.6	12.4	12.5	11.5	19.2	10.9	11.6
20	32.7	17.3	27.5	5.1	15.4	10.1	14.4	12.2	12.9	19.0	12.0	14.9
25	28.8	3.2	24.8	7.1	12.0	8.6	11.6	11.8	11.8	15.2	8.8	10.3
30	30.4	5.4	21.9	10.0	14.0	8.0	10.2	13.9	10.9	17.9	9.4	11.1
35	26.4	11.8	21.4	13.3	14.0	6.7	11.4	6.6	12.8	17.6	10.4	12.4
40	27.0	8.4	19.2	9.5	13.6	6.8	9.8	10.7	10.0	13.2	7.5	7.6
45	29.6	4.4	20.4	4.1	13.5	11.8	9.6	19.6	11.4	14.9	8.5	9.9
50	28.0	7.8	21.0	9.7	14.4	17.3	10.2	14.3	8.7	15.8	9.0	9.7
55	28.4	8.9	19.9	9.0	14.4	5.5	11.4	9.2	11.6	15.0	10.8	12.3
60	26.1	9.2	17.4	8.0	13.4	10.3	10.7	8.9	10.3	16.3	9.7	11.0
65	28.0	5.6	18.0	7.4	13.6	8.4	9.9	10.3	11.7	14.9	8.8	10.1
75	25.3	12.0	17.7	8.3	12.5	11.9	8.8	11.5	10.2	13.8	9.8	8.4

1/ Average of 10 observations.
2/ C = coefficient of variation.

Table 6. - Breaking strength and elongation of the sheetings before and after laundering - Continued

Times laundered	Breaking strength 1/								Elongation 1/			
	Dry				Wet				Dry		Wet	
	Warp		Filling		Warp		Filling		Warp	Filling	Warp	Filling
	Mean	C 2/	Mean	C	Mean	C	Mean	C				
No.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.
					All-rayon fabric							
0	40.1	7.2	30.1	7.1	18.8	9.5	11.8	8.1	15.8	19.9	14.9	12.3
5	43.5	6.4	34.4	5.8	17.3	11.7	15.8	11.4	17.2	26.2	19.8	20.8
10	35.4	6.7	31.4	7.5	17.0	5.3	16.8	5.1	19.6	24.9	19.5	22.7
15	31.6	13.0	30.8	11.0	15.8	9.8	15.1	13.0	19.8	27.7	22.5	21.7
20	31.2	7.9	29.0	6.2	13.8	17.8	15.4	15.8	22.2	29.4	23.1	27.1
25	31.6	6.2	32.0	7.1	12.0	5.6	13.7	8.3	16.7	23.5	20.4	22.0
30	28.6	10.0	29.2	16.1	12.2	4.0	13.6	8.8	19.2	26.4	19.6	23.2
35	26.8	8.0	26.2	9.1	12.4	4.4	12.8	7.4	20.6	27.4	18.9	21.5
40	28.1	10.3	25.0	7.2	10.8	18.5	11.8	7.9	17.0	24.7	16.1	21.0
45	25.6	9.6	23.0	21.0	12.2	1.5	11.9	22.8	18.6	26.5	19.3	18.5
50	27.2	6.2	26.7	9.3	12.4	11.1	13.1	5.6	20.5	28.6	21.6	23.6
55	23.8	7.1	22.9	12.3	10.8	12.4	13.4	6.4	23.3	28.0	24.5	23.6
60	24.8	6.6	26.0	6.3	11.0	7.6	13.4	9.9	23.9	35.0	25.0	24.5
65	26.8	8.8	25.6	10.6	11.0	15.3	12.8	8.1	23.7	27.9	22.0	23.8
75	24.2	6.7	26.0	6.6	10.7	5.9	11.9	5.9	23.7	32.2	21.1	22.4

1/ Average of 10 observations.
2/ C = coefficient of variation.

Table 7. - Some physical and chemical properties of the sheetings before and after laundering

Times laundered	Yarns per inch 1/ Warp	Yarns per inch 1/ Filling	Weight 1/ per square yard	Shrinkage 2/ Warp	Shrinkage 2/ Filling	Breaking strength index 3/ Dry Warp	Breaking strength index 3/ Dry Filling	Breaking strength index 3/ Wet Warp	Breaking strength index 3/ Wet Filling	Fluidity in cuprammonium hydroxide 4/	Degree of polymerization 5/
No.	No.	No.	Oz.	Pct.	Pct.					Rhes	
					All-cotton fabric						
0	74	63	4.6	...	...	0.68	0.60	0.86	0.85	4.28	6480
5	72	64	5.1	...	...	.72	.69	.75	.95	5.49	6270
10	75	67	5.0	0.0	7.2	.59	.71	.71	.72	5.22	6270
15	74	64	5.1	...	...	.65	.59	.71	.65	6.11	6180
20	75	65	4.8	1.8	5.8	.67	.66	.69	.80	5.72	....
25	71	65	4.8	...	...	.74	.77	.86	.91	5.76	6030
30	74	64	4.8	1.1	6.6	.64	.67	.84	.80	....	....
35	74	64	4.5	...	...	.61	.69	.69	.80	5.98	6400
40	74	64	4.9	1.2	7.2	.69	.66	.78	.75	....	....
45	72	66	4.8	...	...	.70	.70	.83	.75	5.46	....
50	73	63	5.0	0.8	4.9	.70	.72	.70	.72	....	....
55	74	64	4.7	...	...	.69	.72	.69	.68	5.83	6140
60	73	64	5.0	2.8	5.4	.58	.67	.61	.63	....	....
65	74	62	4.4	...	...	.64	.62	.74	.68	5.77	....
75	75	63	4.6	...	...	.66	.63	.76	.69	6.03	5840
					5/6 cotton-1/6 rayon fabric						
0	65	63	3.9	...	....	.53	.50	.62	.61	3.69	5170
5	73	64	4.9	...	....	.62	.55	.62	.66	5.02	4400
10	75	66	4.8	4.2	12.3	.55	.60	.59	.60	5.57	4490
15	73	65	4.9	...	....	.53	.50	.58	.54	5.02	4440
20	74	66	4.7	3.3	13.5	.62	.62	.68	.67	5.01	....
25	73	64	4.4	...	....	.60	.58	.66	.60	5.13	4480
30	73	63	4.4	3.9	10.8	.60	.55	.64	.61	....	....
35	73	64	4.2	...	....	.62	.58	.64	.64	4.81	4520
40	75	63	4.7	4.6	10.9	.58	.52	.64	.63	....	....
45	72	66	4.9	...	....	.63	.57	.65	.60	4.86	....
50	72	66	4.6	3.7	11.1	.59	.58	.58	.58	....	....
55	75	65	4.6	...	....	.56	.61	.61	.66	5.04	4430
60	72	64	4.7	2.8	14.7	.55	.57	.62	.57	....	....
65	74	63	4.6	...	....	.58	.57	.60	.57	5.18	....
75	73	66	4.4	...	....	.55	.54	.57	.52	5.32	4500

See footnotes at end of table.

Table 7. - Some physical and chemical properties of the sheetings before and after laundering - Continued

Times laundered	Yarns per inch 1/ Warp	Yarns per inch 1/ Filling	Weight 1/ per square yard	Shrinkage 2/ Warp	Shrinkage 2/ Filling	Breaking strength index 3/ Dry Warp	Breaking strength index 3/ Dry Filling	Breaking strength index 3/ Wet Warp	Breaking strength index 3/ Wet Filling	Fluidity in cuprammonium hydroxide 4/	Degree of polymerization 5/
No.	No.	No.	Oz.	Pct.	Pct.					Rhes	
				4/6 cotton-2/6 rayon fabric							
0	66	62	4.1	...	....	0.51	0.49	0.58	0.48	2.73	4280
5	73	66	5.0	...	....	.59	.51	.58	.56	3.72	3800
10	75	65	5.0	4.6	12.6	.60	.58	.56	.58	3.50	3910
15	74	65	5.0	...	....	.62	.58	.62	.61	3.86	3730
20	76	66	4.7	3.8	14.3	.42	.49	.42	.53	3.49	....
25	73	69	4.8	...	....	.59	.60	.59	.59	3.51	3770
30	74	64	4.8	3.9	14.2	.50	.49	.59	.56	....	....
35	74	64	4.3	...	....	.56	.54	.54	.48	3.51	3720
40	75	65	4.9	6.1	13.4	.55	.50	.51	.47	....	....
45	74	66	4.9	...	....	.58	.41	.54	.42	3.63	....
50	74	64	4.8	3.9	13.5	.59	.55	.56	.54	....	....
55	75	63	4.7	...	....	.51	.53	.55	.52	3.83	3560
60	75	64	4.8	4.7	13.9	.53	.55	.54	.40	....	....
65	74	67	5.3	...	....	.55	.52	.53	.47	3.83	....
75	74	62	4.6	...	....	.56	.55	.52	.47	3.95	3780
				3/6 cotton-3/6 rayon fabric							
0	66	61	4.1	...	....	.51	.37	.40	.35	3.29	3130
5	74	64	4.9	...	....	.53	.49	.46	.46	3.56	3120
10	75	65	5.1	4.4	12.6	.56	.51	.46	.44	3.54	3010
15	75	66	5.0	...	....	.48	.50	.45	.43	3.63	3010
20	77	66	4.9	7.7	13.3	.44	.43	.42	.42	3.63	....
25	73	67	5.0	...	....	.58	.55	.46	.46	3.92	2960
30	75	66	4.8	4.1	11.8	.54	.51	.46	.45	....	....
35	76	64	4.3	...	....	.52	.47	.42	.38	3.86	3120
40	77	64	4.8	7.1	13.3	.55	.50	.42	.39	....	....
45	75	66	4.9	...	....	.53	.39	.44	.38	3.79	....
50	74	65	4.7	4.9	14.0	.52	.47	.41	.41	....	....
55	74	64	4.5	...	....	.50	.43	.44	.34	3.87	2980
60	74	64	4.7	4.7	15.1	.50	.52	.43	.34	....	....
65	77	64	4.8	...	....	.48	.48	.43	.37	3.87	....
75	75	67	4.5	...	....	.52	.43	.51	.33	3.92	3190

See footnotes at end of table.

Table 7. - Some physical and chemical properties of the sheetings before and after laundering - Continued

Times laundered	Yarns per inch 1/ Warp	Yarns per inch 1/ Filling	Weight 1/ per square yard	Shrinkage 2/ Warp	Shrinkage 2/ Filling	Breaking strength index 3/ Dry Warp	Breaking strength index 3/ Dry Filling	Breaking strength index 3/ Wet Warp	Breaking strength index 3/ Wet Filling	Fluidity in cuprammonium hydroxide 4/	Degree of polymerization 5/
No.	No.	No.	Oz.	Pct.	Pct.					Rhes	
				2/6 cotton-4/6 rayon fabric							
0	66	62	4.2	...	....	0.47	0.45	0.30	0.25	4.22	2290
5	75	66	4.9	...	....	.51	.52	.34	.36	4.47	2120
10	76	65	5.1	5.7	14.9	.53	.53	.37	.39	4.32	2090
15	75	66	5.1	...	....	.44	.43	.33	.30	4.54	2190
20	77	66	5.2	7.2	14.7	.49	.48	.36	.36	4.53	....
25	76	68	4.7	...	....	.49	.50	.31	.36	4.75	2260
30	76	63	4.4	5.4	11.8	.49	.46	.36	.32	....	....
35	75	69	4.7	...	....	.45	.44	.33	.32	4.38	2240
40	75	65	4.9	7.2	12.5	.49	.43	.35	.36	....	....
45	75	67	4.8	...	....	.50	.43	.33	.30	4.52	....
50	76	63	4.6	7.2	11.9	.48	.43	.34	.31	....	....
55	75	64	4.7	...	....	.44	.40	.33	.33	4.74	2220
60	75	63	4.8	6.9	13.0	.35	.34	.31	.30	....	....
65	75	64	4.8	...	....	.46	.39	.33	.26	4.72	....
75	74	62	4.4	...	....	.46	.44	.31	.27	5.13	2250
				1/6 cotton-5/6 rayon fabric							
0	67	62	4.1	...	....	.40	.31	.12	.10	8.06	1290
5	77	64	4.8	...	....	.47	.39	.20	.18	8.72	1320
10	77	66	4.9	8.3	14.3	.44	.40	.20	.20	8.77	1280
15	76	67	5.0	...	....	.43	.40	.20	.19	8.49	1320
20	76	68	4.8	7.2	12.9	.43	.40	.20	.21	8.81	....
25	73	68	4.4	...	....	.39	.36	.16	.17	8.92	1250
30	76	64	4.3	11.1	9.3	.40	.34	.18	.16	....	....
35	74	65	4.3	....	...	.36	.33	.19	.18	8.65	1300
40	78	66	4.6	15.8	5.2	.35	.29	.17	.15	....	....
45	73	69	4.6	....	...	.41	.30	.18	.14	8.76	....
50	75	64	4.2	12.2	5.7	.37	.33	.19	.16	....	....
55	76	66	4.4	....	...	.37	.30	.19	.17	8.96	1360
60	76	65	4.5	15.6	3.7	.34	.27	.18	.16	....	....
65	77	64	4.5	....	...	.36	.28	.18	.16	8.89	....
75	75	65	4.2	....	...	.34	.27	.17	.14	8.73	1250

See footnotes at end of table.

Table 7. - Some physical and chemical properties of the sheetings before and after laundering - Continued

Times laundered	Yarns per inch 1/ Warp	Yarns per inch 1/ Filling	Weight 1/ per square yard	Shrinkage 2/ Warp	Shrinkage 2/ Filling	Breaking strength index 3/ Dry Warp	Breaking strength index 3/ Dry Filling	Breaking strength index 3/ Wet Warp	Breaking strength index 3/ Wet Filling	Fluidity in cuprammonium hydroxide 4/	Degree of polymerization 5/
No.	No.	No.	Oz.	Pct.	Pct.					Rhes	
					All-rayon fabric						
0	73	64	4.6	....	...	0.55	0.47	0.26	0.18	9.65	910
5	80	69	5.5	....	...	.54	.50	.22	.23	10.64	940
10	80	69	5.4	8.3	13.7	.44	.46	.21	.24	10.73	890
15	80	70	6.0	....	....	.40	.44	.20	.22	10.66	870
20	81	72	5.8	17.2	16.9	.39	.40	.17	.21	10.72	...
25	77	70	5.3	....	....	.41	.46	.16	.20	10.84	900
30	78	71	5.5	16.2	17.1	.37	.41	.16	.19	.....	...
35	80	71	5.3	....	....	.34	.37	.16	.18	10.72	920
40	82	72	5.9	21.2	18.6	.34	.35	.13	.16	.....	...
45	82	70	5.7	....	....	.31	.33	.15	.17	10.61	...
50	79	71	5.6	19.4	18.9	.34	.38	.16	.18	.....	...
55	80	75	6.1	....	....	.30	.31	.14	.18	10.70	910
60	81	74	6.2	21.4	22.1	.31	.35	.14	.18	.....	...
65	82	74	6.1	....	....	.33	.35	.13	.17	10.83	...
75	83	73	5.7	....	....	.29	.36	.13	.16	10.82	910

1/ After finishing; average of 5 observations.
2/ Average of 3 determinations.
3/ Breaking strength divided by yarns per inch.
4/ Fluidity is the reciprocal of the viscosity of dispersions of cellulose in cuprammonium hydroxide.
5/ The degree of polymerization (D.P.) was calculated from the viscosity of dispersions of cellulose nitrate in butyl acetate.

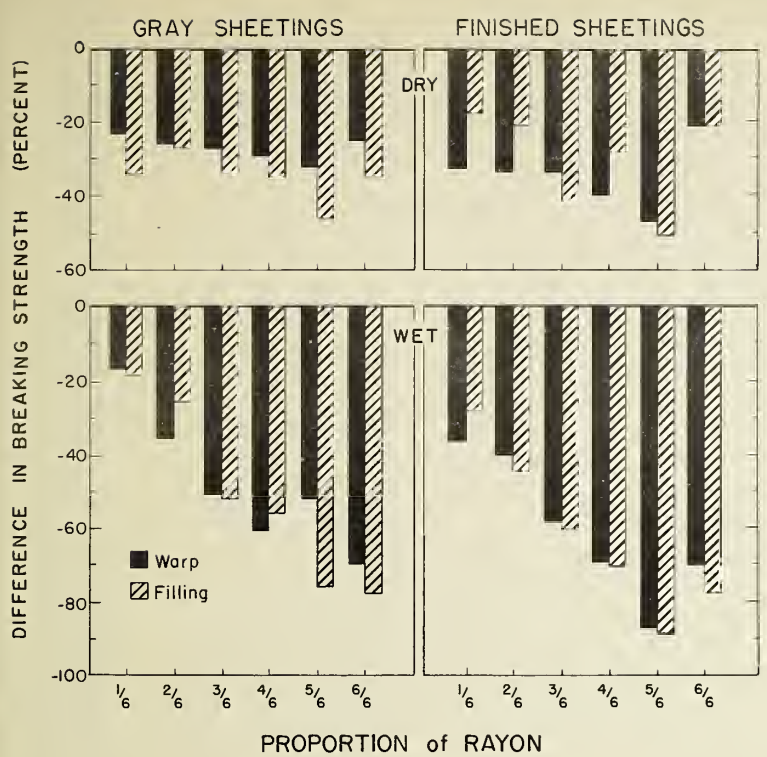

Figure 1.--Percent difference in breaking strength of sheetings composed entirely of rayon and of blends of cotton and rayon, based on breaking strength of the all-cotton sheeting .

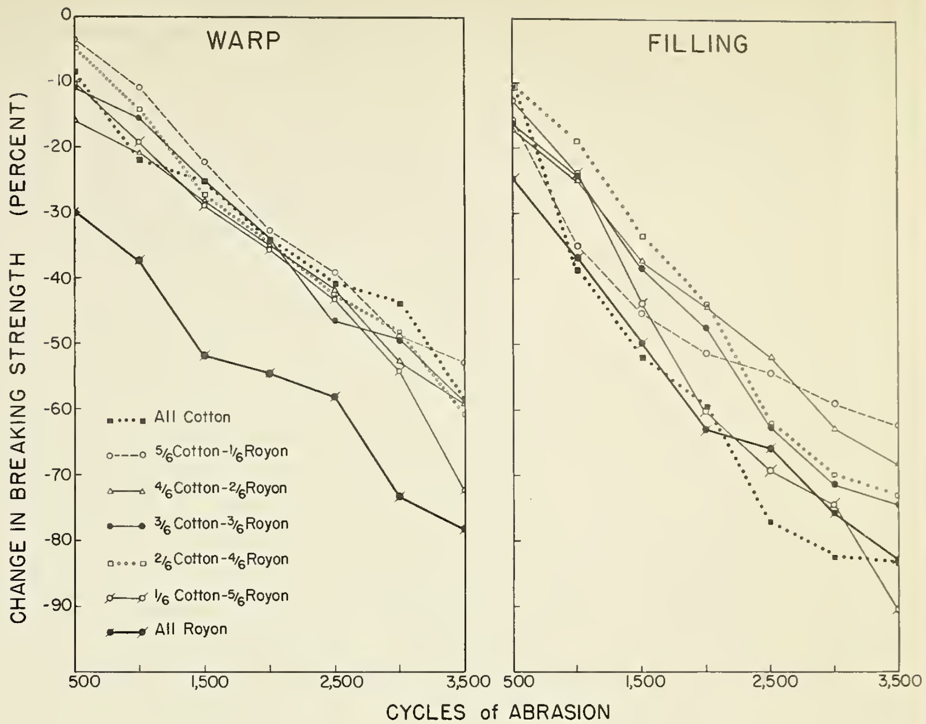

Figure 2.--Percent change in breaking strength of sheetings as a result of abrasion .